

PROTOLON (SMK)-LWL (N)TSKCGEWOEU 3,6/6KV

Medium voltage reeling cable with fibre-optics



Flexible medium voltage reeling cable with integrated fibre-optics for the combined transmission of energy and data, for application under high or extreme mechanical stresses, e.g. high travel speeds, dynamic tensile loads, multiple changes of direction into different planes, churning on running over rollers and torsional stresses. Mainly for mobile equipment, e.g. fast-moving container cranes and large moving equipment.

STANDARDS / APPROVALS

Based on DIN VDE 0250-813

DIN VDE 0298-4

DIN EN 60228 / IEC 60228 / VDE 0295

DIN EN 60811-404 / IEC 60811-404

Reversed bending; roller bending; torsional stress

GOST -R/-K/-B Fire Certificate of Russian Federation

General

Electrical parameters

Conductor

Chemical behaviour

Mechanical parameters

Certifications / Approvals

CABLE DESIGN

Conductor

Very finely stranded copper, tinned (class FS)

PE: Very finely stranded copper, tinned (class FS)

Inner semi-conducting layer

Yes

-

Semi-conductive EPR

Core insulation material

EPR rubber

-

PROTOLON HS

-

Special compound > 3GI3

Outer semi-conducting layer

Yes

-

Semi-conductive NBR easy-strip

Core arrangement

Three core design, with split earth conductor and optical element in the interstices;

Optical element: six tubes, laid up around a central support element, each with one, two, three or four optical fibers

Material inner sheath

Rubber - polychloroprene (PCP)

-

PROTOFIRM

-

Special sandwich EPR/CR

Armouring/reinforcement

Braiding

Armouring/reinforcement material

Polyester

Material outer sheath

Rubber - polychloroprene (PCP)

-

PROTOFIRM

-

Special compound > 5GM5

ELECTRICAL PARAMETERS

Rated voltage U ₀ /U (Um)	3.6/6 (7.2) kV
Test voltage [kV]	11
Nominal voltage U [V]	6,000

THERMAL PARAMETERS

Max. conductor temperature [°C]	90
Max. conductor temperature at short circuit [°C]	250
Ambient temperature fix installation (min) [°C]	-50
Ambient temperature fix installation (max) [°C]	80
Ambient temperature flexible installation (min) [°C]	-35
Ambient temperature flexible installation (max) [°C]	80

CHEMICAL PARAMETERS

Oil resistant	Yes
Ozone resistance	Yes
Resistant to UV	Yes
Sea water resistance	Yes

OPTICAL FIBER PROPERTIES

Fiber type	G62,5/125 µm Multi-mode graded index	G50/125 µm Multi-mode graded index	E9/125 µm Single-mode graded index
Cladding diameter	125 µm	125 µm	125 µm
Fiber diameter	250 µm	250 µm	250 µm
Attenuation at 850 nm	< 3,3 dB/km	< 2,8 dB/km	
Attenuation at 1310 nm	< 0,9 dB/km	< 0,8 dB/km	< 0,4 dB/km
Attenuation at 1550 nm			< 0,3 dB/km
Bandwidth at 850 nm	> 400 MHz	> 400 MHz	
Bandwidth at 1310 nm	> 600 MHz	> 1200 MHz	
Numerical Aperture	0,275 +/- 0,02	0,2 +/- 0,02	0,14 +/- 0,02
Chromatic Dispersion at 1300 nm			< 3,5 ps/nm km
Chromatic Dispersion at 1550 nm			< 18 ps/nm km

MECHANICAL PARAMETERS

Torsional stress +/- [°/m]	25
Permanent tensile strength (rule)	20 N/mm² static 30 N/mm² dynamic
Travel speed	- Gantry (reeling operation): no restriction. For speeds beyond 240 m/min it is recommended to consult the cable manufacturer
Bending radius (rule)	Acc. to VDE 0298-3: 6 X D fixed installation 10 X D flexible operation 20 X D min distance with S-type directional changes

CABLE PROPERTIES

Basic construction	SAP code	External code	Diameter conductor [mm]	Cable diameter (min) [mm]	Cable diameter (max) [mm]	Cable weight [kg/km]
3x25+2x25/2 +1x(6G62,5)	20160301	5DK3081	7.1	39.9	42.9	2,720
3x35+2x25/2 +1x(6G62,5)	20004468	5DK3082	8.3	42	45	3,100
3x50+2x25/2 +1x(6G62,5)	20004469	5DK3083	9.9	44.8	47.8	3,840
3x70+2x35/2 +1x(6G62,5)	20004470	5DK3084	11.8	49.9	53.9	4,940
3x95+2x50/2 +1x(6G62,5)	20004471	5DK3085	13.8	54.8	58.8	6,050
3x120+2x70/2 +1x(6G62,5)	20008293	5DK3086	15.4	58.2	62.2	7,350
3x150+2x70/2 +1x(6G62,5)	20007743	5DK3100	17.2	63.5	67.5	8,650
3x185+2x95/2 +1x(12G62,5)	20173656	5DK3089	19	68	72	10,300

CABLE PROPERTIES ELECTRICAL / MECHANICAL

Basic construction	SAP code	External code	Max. tensile strength [N]	Max. tensile strength during acceleration [N]	Bending radius moving (min) [mm]	Conductor resistance at 20° C [Ohm/km]	Current carrying capacity [A]
3x25+2x25/2+1x(6G62,5)	20160301	5DK3081	1,500	2,250	429	0.795	131
3x35+2x25/2+1x(6G62,5)	20004468	5DK3082	2,100	3,150	450	0.565	162
3x50+2x25/2+1x(6G62,5)	20004469	5DK3083	3,000	4,500	478	0.393	202
3x70+2x35/2+1x(6G62,5)	20004470	5DK3084	4,200	6,300	539	0.277	250
3x95+2x50/2+1x(6G62,5)	20004471	5DK3085	5,700	8,550	588	0.21	301
3x120+2x70/2+1x(6G62,5)	20008293	5DK3086	7,200	10,800	622	0.164	352
3x150+2x70/2+1x(6G62,5)	20007743	5DK3100	9,000	13,500	675	0.132	404
3x185+2x95/2+1x(12G62,5)	20173656	5DK3089	11,100	16,650	720	0.11	461

Current carrying capacity acc. VDE 0298-4, Tab. 15, on a surface at 30°C ambient temperature.

Design with 6, 12, 18 or 24 fibers, in G62,5, G50 and E9 available upon request. Further combination with different fiber types is also possible.

PROTOLON (SMK)-LWL (N)TSKCGEWOEU 6/10KV

Medium voltage reeling cable with fibre-optics



Flexible medium voltage reeling cable with integrated fibre-optics for the combined transmission of energy and data, for application under high or extreme mechanical stresses, e.g. high travel speeds, dynamic tensile loads, multiple changes of direction into different planes, churning on running over rollers and torsional stresses. Mainly for mobile equipment, e.g. fast-moving container cranes and large moving equipment.

STANDARDS / APPROVALS

Based on DIN VDE 0250-813

GOST -R/-K/-B Fire Certificate of Russian Federation

DIN EN 60228 / IEC 60228 / VDE 0295

DIN VDE 0298-4

Reversed bending; roller bending; torsional stress

DIN EN 60811-404 / IEC 60811-404

General

Certifications / Approvals

Conductor

Electrical parameters

Mechanical parameters

Chemical behaviour

CABLE DESIGN

Conductor

Very finely stranded copper, tinned (class FS)

PE: Very finely stranded copper, tinned (class FS)

Inner semi-conducting layer

Yes

-

Semi-conductive EPR

Core insulation material

EPR rubber

-

PROTOLON HS

-

Special compound > 3GI3

Outer semi-conducting layer

Yes

-

Semi-conductive NBR easy-strip

Core arrangement

Three core design, with split earth conductor and optical element in the interstices;

Optical element: six tubes, laid up around a central support element, each with one, two, three or four optical fibers

Material inner sheath

Rubber - polychloroprene (PCP)

-

PROTOFIRM

-

Special sandwich EPR/CR

Armouring/reinforcement

Braiding

Armouring/reinforcement material

Polyester

Material outer sheath

Rubber - polychloroprene (PCP)

-

PROTOFIRM

-

Special compound > 5GM5

ELECTRICAL PARAMETERS

Rated voltage U ₀ /U (Um)	6/10 (12) kV
Test voltage [kV]	17
Nominal voltage U [V]	10,000

THERMAL PARAMETERS

Max. conductor temperature [°C]	90
Max. conductor temperature at short circuit [°C]	250
Ambient temperature fix installation (min) [°C]	-50
Ambient temperature fix installation (max) [°C]	80
Ambient temperature flexible installation (min) [°C]	-35
Ambient temperature flexible installation (max) [°C]	80

CHEMICAL PARAMETERS

Oil resistant	Yes
Ozone resistance	Yes
Resistant to UV	Yes
Sea water resistance	Yes

OPTICAL FIBER PROPERTIES

Fiber type	G62,5/125 µm Multi-mode graded index	G50/125 µm Multi-mode graded index	E9/125 µm Single-mode graded index
Cladding diameter	125 µm	125 µm	125 µm
Fiber diameter	250 µm	250 µm	250 µm
Attenuation at 850 nm	< 3,3 dB/km	< 2,8 dB/km	
Attenuation at 1310 nm	< 0,9 dB/km	< 0,8 dB/km	< 0,4 dB/km
Attenuation at 1550 nm			< 0,3 dB/km
Bandwidth at 850 nm	> 400 MHz	> 400 MHz	
Bandwidth at 1310 nm	> 600 MHz	> 1200 MHz	
Numerical Aperture	0,275 +/- 0,02	0,2 +/- 0,02	0,14 +/- 0,02
Chromatic Dispersion at 1300 nm			< 3,5 ps/nm km
Chromatic Dispersion at 1550 nm			< 18 ps/nm km

MECHANICAL PARAMETERS

Torsional stress +/- [°/m]	25
Permanent tensile strength (rule)	20 N/mm² static 30 N/mm² dynamic
Travel speed	- Gantry (reeling operation): no restriction. For speeds beyond 240 m/min it is recommended to consult the cable manufacturer
Bending radius (rule)	Acc. to VDE 0298-3: 6 X D fixed installation 10 X D flexible operation 20 X D min distance with S-type directional changes

CABLE PROPERTIES

Basic construction	SAP code	External code	Diameter conductor [mm]	Cable diameter (min) [mm]	Cable diameter (max) [mm]	Cable weight [kg/km]
3x25+2x25/2 +1x(6G62,5LWL)	20004548	5DK4081	7.1	40.7	43.7	2,750
3x35+2x25/2 +1x(6G62,5LWL)	20004549	5DK4082	8.3	42.7	45.7	3,160
3x50+2x25/2 +1x(6G62,5LWL)	20004550	5DK4083	9.9	46.1	49.1	3,840
3x70+2x35/2 +1x(6G62,5LWL)	20004551	5DK4084	11.8	51.1	55.1	5,010
3x95+2x50/2 +1x(6G62,5LWL)	20004552	5DK4085	13.8	56.1	60.1	6,300
3x120+2x70/2 +1x(6G62,5LWL)	20006945	5DK4086	15.4	60.9	64.9	7,660
3x150+2x70/2 +1x(6G62,5LWL)	20004553	5DK4087	17.2	64.8	68.8	8,990
3x185+2x95/2 +1x(6G62,5LWL)	20007673	5DK4088	19	69.3	73.3	10,690
3x240+2x120/2 +1x(6G62,5LWL)	20035801	5DK4090	21.8	76.7	80.7	13,410
3x300+2x150/2 +1x(6G62,5LWL)	20167801	5DK4091	24.4	84.2	89.2	15,880

CABLE PROPERTIES ELECTRICAL / MECHANICAL

Basic construction	SAP code	External code	Max. tensile strength [N]	Max. tensile strength during acceleration [N]	Bending radius moving (min) [mm]	Conductor resistance at 20° C [Ohm/km]	Current carrying capacity [A]
3x25+2x25/2 +1x(6G62,5LWL)	20004548	5DK4081	1,500	2,250	437	0.795	131
3x35+2x25/2 +1x(6G62,5LWL)	20004549	5DK4082	2,100	3,150	457	0.565	162
3x50+2x25/2 +1x(6G62,5LWL)	20004550	5DK4083	3,000	4,500	491	0.393	202
3x70+2x35/2 +1x(6G62,5LWL)	20004551	5DK4084	4,200	6,300	551	0.277	250
3x95+2x50/2 +1x(6G62,5LWL)	20004552	5DK4085	5,700	8,550	601	0.21	301
3x120+2x70/2 +1x(6G62,5LWL)	20006945	5DK4086	7,200	10,800	649	0.164	352
3x150+2x70/2 +1x(6G62,5LWL)	20004553	5DK4087	9,000	13,500	688	0.132	404
3x185+2x95/2 +1x(6G62,5LWL)	20007673	5DK4088	11,100	16,650	733	0.108	461
3x240+2x120/2 +1x(6G62,5LWL)	20035801	5DK4090	14,400	21,600	807	0.0817	540
3x300+2x150/2 +1x(6G62,5LWL)	20167801	5DK4091	18,000	27,000	892	0.0654	620

Current carrying capacity acc. VDE 0298-4, Tab. 15, on a surface at 30°C ambient temperature.

Design with 6, 12, 18 or 24 fibers, in G62,5, G50 and E9 available upon request. Further combination with different fiber types is also possible.

PROTOLON (SMK)-LWL (N)TSKCGEWOEU 8,7/15KV

Medium voltage reeling cable with fibre-optics



Flexible medium voltage reeling cable with integrated fibre-optics for the combined transmission of energy and data, for application under high or extreme mechanical stresses, e.g. high travel speeds, dynamic tensile loads, multiple changes of direction into different planes, churning on running over rollers and torsional stresses. Mainly for mobile equipment, e.g. fast-moving container cranes and large moving equipment.

STANDARDS / APPROVALS

Based on DIN VDE 0250-813

DIN VDE 0298-4

DIN EN 60228/ IEC 60228 / VDE 0295

DIN EN 60811-404 / IEC 60811-404

Reversed bending; roller bending; torsional stress

GOST -R/-K/-B Fire Certificate of Russian Federation

General

Electrical parameters

Conductor

Chemical behaviour

Mechanical parameters

Certifications / Approvals

CABLE DESIGN

Conductor

Very finely stranded copper, tinned (class FS)

PE: Very finely stranded copper, tinned (class FS)

Inner semi-conducting layer

Yes

-

Semi-conductive EPR

Core insulation material

EPR rubber

-

PROTOLON HS

-

Special compound > 3GI3

Outer semi-conducting layer

Yes

-

Semi-conductive NBR easy-strip

Core arrangement

Three core design, with split earth conductor and optical element in the interstices;

Optical element: six tubes, laid up around a central support element, each with one, two, three or four optical fibers

Material inner sheath

Rubber - polychloroprene (PCP)

-

PROTOFIRM

-

Special sandwich EPR/CR

Armouring/reinforcement

Braiding

Armouring/reinforcement material

Polyester

Material outer sheath

Rubber - polychloroprene (PCP)

-

PROTOFIRM

-

Special compound > 5GM5

ELECTRICAL PARAMETERS

Rated voltage U ₀ /U (Um)	8.7/15 (17.5) kV
Test voltage [kV]	24
Nominal voltage U [V]	15,000

THERMAL PARAMETERS

Max. conductor temperature [°C]	90
Max. conductor temperature at short circuit [°C]	250
Ambient temperature fix installation (min) [°C]	-50
Ambient temperature fix installation (max) [°C]	80
Ambient temperature flexible installation (min) [°C]	-35
Ambient temperature flexible installation (max) [°C]	80

CHEMICAL PARAMETERS

Oil resistant	Yes
Ozone resistance	Yes
Resistant to UV	Yes
Sea water resistance	Yes

OPTICAL FIBER PROPERTIES

Fiber type	G62,5/125 µm Multi-mode graded index	G50/125 µm Multi-mode graded index	E9/125 µm Single-mode graded index
Cladding diameter	125 µm	125 µm	125 µm
Fiber diameter	250 µm	250 µm	250 µm
Attenuation at 850 nm	< 3,3 dB/km	< 2,8 dB/km	
Attenuation at 1310 nm	< 0,9 dB/km	< 0,8 dB/km	< 0,4 dB/km
Attenuation at 1550 nm			< 0,3 dB/km
Bandwidth at 850 nm	> 400 MHz	> 400 MHz	
Bandwidth at 1310 nm	> 600 MHz	> 1200 MHz	
Numerical Aperture	0,275 +/- 0,02	0,2 +/- 0,02	0,14 +/- 0,02
Chromatic Dispersion at 1300 nm			< 3,5 ps/nm km
Chromatic Dispersion at 1550 nm			< 18 ps/nm km

MECHANICAL PARAMETERS

Torsional stress +/- [°/m]	25
Permanent tensile strength (rule)	20 N/mm² static 30 N/mm² dynamic
Travel speed	- Gantry (reeling operation): no restriction. For speeds beyond 240 m/min it is recommended to consult the cable manufacturer
Bending radius (rule)	Acc. to VDE 0298-3: 6 X D fixed installation 10 X D flexible operation 20 X D min distance with S-type directional changes

CABLE PROPERTIES

Basic construction	SAP code	External code	Diameter conductor [mm]	Cable diameter (min) [mm]	Cable diameter (max) [mm]	Cable weight [kg/km]
3x25+2x25/2 +1x(6G62,5)	20004664	5DK5078	7.1	43.5	46.5	3,000
3x35+2x25/2 +1x(6G62,5)	20004667	5DK5082	8.3	46.1	49.1	3,500
3x50+2x25/2 +1x(6G62,5)	20004668	5DK5083	9.9	50.5	54.5	4,400
3x70+2x35/2 +1x(6G62,5)	20004669	5DK5084	11.8	55.2	59.2	5,350
3x95+2x50/2 +1x(6G62,5)	SMK_L_15KV_006	5DK5***	13.8	60.9	64.9	6,950
3x120+2x70/2 +1x(6G62,5)	SMK_L_15KV_001	5DK5***	15.4	64.4	68.4	8,100
3x150+2x70/2 +1x(6G62,5)	SMK_L_15KV_002	5DK5***	17.2	68.8	72.8	9,450
3x185+2x95/2 +1x(6G62,5)	SMK_L_15KV_003	5DK5***	19	74.1	78.1	11,300
3x240+2x120/2 +1x(6G62,5)	SMK_L_15KV_004	5DK5***	21.8	80.8	84.8	14,050
3x300+2x150/2 +1x(6G62,5)	SMK_L_15KV_005	5DK5***	24.4	87.7	92.7	17,100

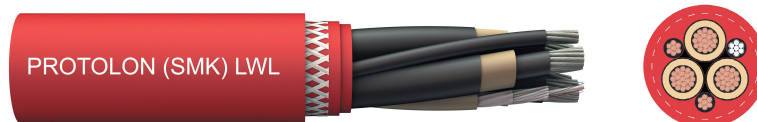
CABLE PROPERTIES ELECTRICAL / MECHANICAL

Basic construction	SAP code	External code	Max. tensile strength [N]	Max. tensile strength during acceleration [N]	Bending radius moving (min) [mm]	Conductor resistance at 20° C [Ohm/km]	Current carrying capacity [A]
3x25+2x25/2+1x(6G62,5)	20004664	5DK5078	1,500	2,250	465	0.795	139
3x35+2x25/2+1x(6G62,5)	20004667	5DK5082	2,100	3,150	491	0.565	172
3x50+2x25/2+1x(6G62,5)	20004668	5DK5083	3,000	4,500	545	0.393	215
3x70+2x35/2+1x(6G62,5)	20004669	5DK5084	4,200	6,300	592	0.277	265
3x95+2x50/2+1x(6G62,5)	SMK_L_15KV_006	5DK5***	5,700	8,550	649	0.21	319
3x120+2x70/2+1x(6G62,5)	SMK_L_15KV_001	5DK5***	7,200	10,800	684	0.164	371
3x150+2x70/2+1x(6G62,5)	SMK_L_15KV_002	5DK5***	9,000	13,500	728	0.132	428
3x185+2x95/2+1x(6G62,5)	SMK_L_15KV_003	5DK5***	11,100	16,650	781	0.108	488
3x240+2x120/2+1x(6G62,5)	SMK_L_15KV_004	5DK5***	14,400	21,600	848	0.0817	574
3x300+2x150/2+1x(6G62,5)	SMK_L_15KV_005	5DK5***	18,000	27,000	927	0.0654	660

Current carrying capacity acc. VDE 0298-4, Tab. 15, on a surface at 30°C ambient temperature.

Design with 6, 12, 18 or 24 fibers, in G62,5, G50 and E9 available upon request. Further combination with different fiber types is also possible.

PROTOLON(SMK)-LWL (N)TSKCGEWOEU 12/20 kV: medium voltage reeling cable with fibre-optics



Application

Flexible medium voltage reeling cable with integrated fibre-optics for the combined transmission of energy and data, for application under high or extreme mechanical stresses, e.g. high travel speeds, dynamic tensile loads, multiple changes of direction into different planes, churning on running over rollers and torsional stresses.

Mainly for mobile equipment, e.g. fast-moving container cranes and large moving equipment.

Global data

Brand	PROTOLON(SMK)-LWL
Type designation	(N)TSKCGEWOEU
Standard	Based on DIN VDE 0250-813
Certifications / Approvals	GOST-R

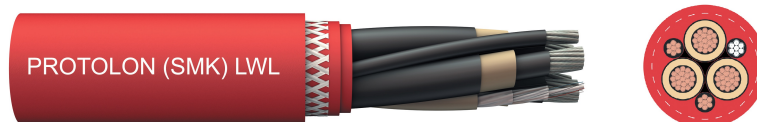
Notes on installation

Notes on installation	Preparation of fibre-optics requires special skills and use of elaborate tools. It is therefore recommended that performance of this work is entrusted to our customer service (Factory assembly). Please provide the connection dimensions.
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Design features

Conductor	Conductor and earth conductor made of electrolytic copper tinned, very finely stranded, class FS (refer also to DIN VDE 0295)			
Insulation	PROTOLON HS High grade special compound based on high-quality EPR (at least 3GI3); improved mechanical and electrical characteristics (refer also to DIN VDE 0207, Part 20).			
Electrical field control	Inner semiconductive layer of EPR, outer semiconductive layer of modified NBR, capable of being stripped when cold and thus extremely easy to prepare (Easy Strip design)			
Core identification	Natural coloured insulation with black semiconductive layer			
Optical Fiber	Fibre core diameter: 62.5, 50 or 9µm; diameter across the cladding: 125µm; diameter over the coating: 250µm. Design available with 6,12, 18 or 24 fibres.			
	Fibre class:	G50/125µm	G62,5/125µm	E9/125µm
	Type:	Graded-index fibre	Graded-index fibre	Monomode fibre
	- Attenuation at 850 nm:	<2,8 dB/km	<3,3 dB/km	-
	- Attenuation at 1310 nm:	<0,8 dB/km	<0,9 dB/km	<0,4 dB/km
	- Attenuation at 1550 nm:	-	-	<0,3 dB/km
	- Bandwidth at 850 nm:	>400 MHz	>400 MHz	-
	- Bandwidth at 1300 nm:	>1200 MHz	>600 MHz	-
	- Numerical aperture:	0,2 ± 0,02	0,275 ± 0,02	0,14 ± 0,02
	- Chromatic dispersion at 1300 nm:	-	-	<3,5 ps/nm km
	- Chromatic dispersion at 1550 nm:	-	-	<3,5 ps/nm km
Fiber coding	Specially developed color code for identification of the individual fibres			
Fiber covering	Hollow core with filling compound, Basic material: ETFE, Compound: 7YI 1, Natural color			
Core arrangement	Three core design with cradle separator in the centre, earth conductor splitted into 2 parts positioned in two interstices. Optical element: six tubes, laid up around a central support element, with one, two or three optical fibers in each, positioned in the third interstice.			
Sheath system	- PROTOFIRM Sandwich - double layer inner sheath: Special compound based on EPR, quality at least 5GM3, also served as water barrier, color: red; - Anti-torsion braid: Reinforced braid made of polyester threads, in a vulcanized bond between the sheaths, resulting in high strength of the sheath system; - PROTOFIRM Sandwich - double layer outer sheath: A sheath system with a unique combination of flexibility and robustness has been achieved through the use of a new sandwich structure. Abrasion and tear-proof high grade rubber compounds based on PCP, quality at least 5GM5, colour: bright red/red.			
Marking	PROTOLON (SMK) LWL (N)TSKCGEWOEU (number of cores)x(cross-section) (rated voltage) (year of manufacture) (serial number)			

PROTOLON(SMK)-LWL (N)TSKCGEWOEU 12/20 kV: medium voltage reeling cable with fibre-optics



Electrical parameters

Rated voltage	12/20 kV
Max. permissible operating voltage AC	13.9/24 kV
Max. permissible operating voltage DC	18/36 kV
AC test voltage	29 kV
EMC	This design exhibits an extremely low interference level as a result of use a symmetrical three-core design with very narrow manufacturing rates.
Data transmission	Special design with fibre-optics for trouble free data transmission at high data rates.
Current Carrying Capacity description	According to DIN VDE 0298, Part 4. Higher values are permissible in specific cases (please consult the manufacturer).

Chemical parameters

Resistance to oil	Acc. to DIN EN 60811-404 and DIN VDE 0473-811-404, paragraph 10
Weather resistance	Unrestricted use outdoors and indoors, resistant to ozone, UV and moisture.
Water resistance	According to HD 2216

Thermal parameters

Max. permissible temperature at conductor	90 °C
Max. short circuit temperature of the conductor	250 °C
Ambient temperature for fixed installation	min -50 °C ; max +80 °C
Ambient temperature in fully flexible operation	min -35 °C ; max +80 °C

Mechanical parameters

Max. tensile load on the conductor	20 N/mm ²
Max. tensile load on the conductor during acceleration	Up to 30 (acc. to DIN VDE 0298 part 3: 15 N/mm ²) N/mm ²
Torsional stress	± 25 °/m
Min. bending radius	Acc. to DIN VDE 0298 part 3
Min. distance with S-type directional changes	20 x D (cable diameter)
Travel speed	- Gantry (reeling operation): no restriction. For speeds beyond 240 m/min it is recommended to consult the cable manufacturer
Additional tests	Reversed bending test, torsional stress test

Number of cores x cross section	Part number	MLFB Number	Conductor diameter max. mm	Earth conductor diameter max. mm	Outer diameter min. mm	Outer diameter max. mm	Bending radius free moving min. mm	Weight (ca.) kg/km	Permissible tensile force max. N	Dynamic tensile force max. N	Conductor resistance at 20°C max. Ω/km	Current carrying capacity (1) A	Short Circuit Current (conductor) kA
3x25 + 2x25/2 + 1x(6G62,5)	20004701	SDK5531	7.1	5	46.6	49.6	496	3200	1500	2250	0.8	139	3.58
3x35 + 2x25/2 + 1x(6G62,5)	20004702	SDK5533	8.3	5	50.1	54.1	541	3880	2100	3150	0.57	172	5.01
3x50 + 2x25/2 + 1x(6G62,5)		SDK5***	9.9	5	54.1	58.1	581	4670	3000	4500	0.39	215	7.15
3x70 + 2x35/2 + 1x(6G62,5)	20168072	SDK5***	11.8	5.9	58.2	62.2	622	5640	4200	6300	0.28	265	10.01
3x95 + 2x50/2 + 1x(6G62,5)		SDK5***	13.8	7.2	64	68	680	7050	5700	8550	0.21	319	13.59
3x120 + 2x70/2 + 1x(6G62,5)		SDK5***	15.4	8.3	68	72	720	8360	7200	10800	0.16	371	17.16
3x150 + 2x70/2 + 1x(6G62,5)	20161633	SDK5***	17.2	8.3	73.3	77.3	773	9840	9000	13500	0.13	428	21.45
3x185 + 2x95/2 + 1x(6G62,5)		SDK5***	19	9.8	77.2	81.2	812	11410	11100	16650	0.11	488	26.46
3x240 + 2x120/2 + 1x(6G62,5)		SDK5***	21.8	11	85.1	90.1	901	14440	14400	21600	0.08	574	34.32
3x300 + 2x150/2 + 1x(6G62,5)		SDK5***	24.4	12	91.3	96.3	963	17810	18000	27000	0.07	660	42.9

Design with 12,18 or 24 fibers and/or G50 or E9 types available upon request.

(1) Nominal current carrying capacity for rubber cables laid on a surface, at 30°C ambient temperature (see also VDE 0298-4, Table 15).

PROTOLON (SMK+HS) (N)TSKCGEWOEU 6/10KV

Medium Voltage reeling cable for High Speed moving cranes



Flexible medium voltage reeling cable with integrated fibre-optics for the combined transmission of energy and data, for application under high or extreme mechanical stresses and very high travel speeds, dynamic tensile loads, multiple changes of direction into different planes, churning on running over rollers and torsional stresses. Especially suitable for fast-moving container cranes (> 240 m/min).

STANDARDS / APPROVALS

Based on DIN VDE 0250-813

DIN VDE 0298-4

DIN EN 60228/ IEC 60228 / VDE 0295

DIN EN 60811-404 / IEC 60811-404

HD 2216

DIN EN 60811-404

Reversed bending; roller bending; torsional stress

General

Electrical parameters

Conductor

Chemical behaviour

Chemical behaviour

Chemical behaviour

Mechanical parameters

CABLE DESIGN

Conductor

Very finely stranded copper, tinned (class FS)

PE: Very finely stranded copper, tinned (class FS)

Inner semi-conducting layer

Yes

-

Semi-conductive EPR

Core insulation material

EPR rubber

-

PROTOLON HS

-

Special compound > 3GI3

Outer semi-conducting layer

Yes

-

Semi-conductive NBR easy-strip

Core arrangement

Three core design, with split earth conductor and optical element in the interstices;

Central aramid support element, embedded into the cradle separator, to increase the max. permissible tensile force on the cable;

Optical element: six tubes, laid up around a central support element, each with one, two, three or four optical fibers

Material inner sheath

Rubber - polychloroprene (PCP)

-

PROTOFIRM

-

Special sandwich EPR/CR

Armouring/reinforcement

Braiding

Armouring/reinforcement material

Polyester

Material outer sheath

Rubber - polychloroprene (PCP)

-

PROTOFIRM

-

Special compound > 5GM5

ELECTRICAL PARAMETERS

Rated voltage U ₀ /U (Um)	6/10 (12) kV
Test voltage [kV]	17
Nominal voltage U [V]	10,000

THERMAL PARAMETERS

Max. conductor temperature [°C]	90
Max. conductor temperature at short circuit [°C]	250
Ambient temperature fix installation (min) [°C]	-50
Ambient temperature fix installation (max) [°C]	80
Ambient temperature flexible installation (min) [°C]	-35
Ambient temperature flexible installation (max) [°C]	80

CHEMICAL PARAMETERS

Oil resistant	Yes
Ozone resistance	Yes
Resistant to UV	Yes
Sea water resistance	Yes

OPTICAL FIBER PROPERTIES

Fiber type	G62,5/125 µm Multi-mode graded index	G50/125 µm Multi-mode graded index	E9/125 µm Single-mode graded index
Cladding diameter	125 µm	125 µm	125 µm
Fiber diameter	250 µm	250 µm	250 µm
Attenuation at 850 nm	< 3,3 dB/km	< 2,8 dB/km	
Attenuation at 1310 nm	< 0,9 dB/km	< 0,8 dB/km	< 0,4 dB/km
Attenuation at 1550 nm			< 0,3 dB/km
Bandwidth at 850 nm	> 400 MHz	> 400 MHz	
Bandwidth at 1310 nm	> 600 MHz	> 1200 MHz	
Numerical Aperture	0,275 +/- 0,02	0,2 +/- 0,02	0,14 +/- 0,02
Chromatic Dispersion at 1300 nm			< 3,5 ps/nm km
Chromatic Dispersion at 1550 nm			< 18 ps/nm km

MECHANICAL PARAMETERS

Torsional stress +/- [°/m]	25
Permanent tensile strength (rule)	Increased tensile load through additional support element (see table)
Travel speed	- Gantry (reeling operation): no restriction. For speeds beyond 270 m/min it is recommended to consult the cable manufacturer
Bending radius (rule)	Acc. to VDE 0298-3: 6 X D fixed installation 10 X D flexible operation 20 X D min distance with S-type directional changes

CABLE PROPERTIES

Basic construction	SAP code	External code	Diameter conductor [mm]	Cable diameter (min) [mm]	Cable diameter (max) [mm]	Cable weight [kg/km]
3x25+2x25/2 +1x(24G62,5)	20205373	5DK4***	7.1	40.7	43.7	2,640
3x35+2x25/2 +1x(24G62,5)	HS_10KV_003	5DK4***	8.3	42.7	45.7	3,150
3x50+2x25/2 +1x(24G62,5)	20227534	5DK4***	9.9	46.1	49.1	3,710
3x70+2x35/2 +1x(24G62,5)	HS_10KV_005	5DK4***	11.8	51.1	55.1	4,870
3x95+2x50/2 +1x(24G62,5)	HS_10KV_006	5DK4***	13.8	56.1	60.1	6,070
3x120+2x70/2 +1x(24G62,5)	HS_10KV_001	5DK4***	15.4	60.9	64.9	7,500

CABLE PROPERTIES ELECTRICAL / MECHANICAL

Basic construction	SAP code	External code	Max. tensile strength [N]	Max. tensile strength during acceleration [N]	Bending radius moving (min) [mm]	Conductor resistance at 20° C [Ohm/km]	Current carrying capacity [A]
3x25+2x25/2 +1x(24G62,5)	20205373	5DK4***	2,200	3,250	437	0.795	131
3x35+2x25/2 +1x(24G62,5)	HS_10KV_003	5DK4***	2,800	4,150	457	0.565	162
3x50+2x25/2 +1x(24G62,5)	20227534	5DK4***	3,700	5,500	491	0.393	202
3x70+2x35/2 +1x(24G62,5)	HS_10KV_005	5DK4***	5,200	7,600	551	0.277	250
3x95+2x50/2 +1x(24G62,5)	HS_10KV_006	5DK4***	7,700	11,350	601	0.21	301
3x120+2x70/2 +1x(24G62,5)	HS_10KV_001	5DK4***	9,500	14,000	649	0.164	352

Current carrying capacity acc. VDE 0298-4, Tab. 15, on a surface at 30°C ambient temperature.

Design with 6, 12, 18 or 24 fibers, in G62,5, G50 and E9 available upon request. Further combination with different fiber types is also possible.